Forensic Sci Med Pathol (2009) 5:47–55
DOI 10.1007/s12024-008-9068-2

Abstracts

Facial soft tissue thicknesses for the Portuguese population

S. Codinha

In recent years, there has been an important increment of studies on the determination of facial soft tissue thicknesses for Europeans for craniofacial identification purposes. In spite of this, there is no information on the particularities of the facial soft tissue depths for the Portuguese population. In order to fulfill this lack, the soft tissue thicknesses of a Portuguese cadaver sample of 151 individuals, 103 males and 48 females with ages between 20 and 99 years old, autopsied at the South Delegation of the National Institute of Legal Medicine where measured using published needle punctured methods at 20 anatomical points. All cadavers' stature and weight was determined and their BMI calculated. In order to prevent postmortem distortion, soft tissue depths were assessed previously to the individual's autopsy in cadavers whose time of death did not exceed 24 h. From this data, average soft tissue depths were calculated considering the BMI, the sex and the age of the cadavers. Correlations between the soft tissues thicknesses and the BMI, sex and age were assessed. The differences between the sexes and the effect of age on the mean soft tissues depths were analysed. Data were also compared with other studies that used identical samples and methods.

Building and using statistical models of facial appearance

Tim Cootes

University of Manchester

Statistical models of the shape and appearance of objects have been developed in the field of Computer Vision to represent and interpret images of deformable objects. They have been applied with particular success to modeling the appearance of the human face, and such models have been used to recognize people, to track their faces and to interpret facial gestures (such as detecting different expressions).

In this talk, I will describe how such models can be constructed from large sets of training images, and give examples of their application.

Multidisciplinary identification of skeletal remains

Dorota Lorkiewicz-Muszynska, Malgorzata Koralewska-Kordel, Monica Abreu-Glowacka

Department of Forensic Medicine, University of Medical Sciences in Poznan, Swiecickiego 6, 60-781 Poznan, Poland

When the skeletal remains are incomplete, the identification process may cause many problems and difficulties. We need to determine if there are any special characteristics that can help identify the remains. Those cases are ideal to test osteological techniques and different identification methods. Several of these techniques, specifically DNA, digital video superimposition, radiological, and dental comparison research were used to identify the victim.

The incomplete skeletal remains were found in the forest. Among remains, there was a skull with the mandible and some bones of postcranial skeleton. The bones were without soft tissue and partially eaten by animals. The skull showed a healed nasal fracture, a healed fracture of the upper ridge of the right orbit and a healed fracture of the left parietal bone. Healed fracture of left femur with evidence of surgical intervention is in area of trohanters. Anthropological analysis demonstrated that the remains originated from a 50- to 55-year-old male.

We have received one photo of missing person (49 years old man), medical documentation which informed about multifragmented fracture of left femur trough trohanters with separate trohanter from the bone, surgical operation and stabilization using metal plate. Genetic material was obtained from the mastoid process using organic method. The material for comparison research was obtained from blood of mother and brother of the missing person using Sherlock AX kit. Samples DNA were amplifying using the AmpFlSTR® Identifiler™ PCR Amplification Kit and AmpFlSTR® Yfiler™ PCR Amplification Kit from Applied Biosystems. Samples were analyzed using automatic genetic analyzer ABI PRISM 310 Applied Biosystems.

Superimposition test showed compatibility of structural traits of all analyzed morphological elements of skull and face, parameters, cranio- and cephalometric points. There was positive identification of features of antemortem femur fracture with medical documentation. Result of DNA examination was positive, too.

Many techniques can be used in an attempt to make a positive identification. In this case, a multidisciplinary process proved to be very helpful in obtaining a positive identification result which was beyond any doubt.

Keywords Human identification, DNA, PCR, Pathology, Superimposition, Radiology

Historical case: face reconstructed with modern identification tools

Dorota Lorkiewicz-Muszynska[1], Wojciech Kociemba[2], Andrzej Lemke[3]

[1]Department of Forensic Medicine, University of Medical Sciences in Poznan, Swiecickiego 6, 60-781 Poznan, Poland; [2]Department of Neuroradiology, University of Medical Sciences in Poznan, Przybyszewskiego 49, 60-355 Poznan, Poland; [3]Department of Radiology, University of Medical Sciences in Poznan, Przybyszewskiego 49, 60-355 Poznan, Poland

The procedure of identifying an individual on the basis of skeletal remains is of interest for anthropologists, anatomists, morphologists, physicians, and criminologists. Results of such procedures carry immense importance, both cognitive, allowing to conclude what is the range of variability of human traits, and practical, in forensic-medical procedures. Methodical aspect of the procedures represents an important problem since reliability of the employed identification techniques determines the probability with which we can reconstruct a supravital outlook of an individual. Theoretical grounds for the criteria used for the person's identification on the basis of skeletal remains are provided by results of studies on variability of anatomic and morphologic structures and on reciprocal relations between soft tissue and bony sublayer on which the soft tissue are distributed.

In March 2007, we have received the skull of Stanislaw Papczynski (May 18, 1631 O.S.—September 17, 1701 N.S.) Marian founder to make anthropological examination and reconstruction of his face. The event of his beatification has taken place in September 2007. We used the forensic-medical practice "POL-SIT Rekonstrukcja" computer-assisted system of supravital face reconstruction represents an universal human face reconstruction system, based on the skull pattern introduced to the computer. The computer tomography (CT) was made employing Siemens Tomograph Somatom Sensation 64. The reconstruction 3D of the skull was made using software "In Space."

The reconstructed face was compared with portraits of blessed Stanislaw Papczynski. Two of them were probably painted during his live or short time after his death. The similarity was high. The remaining one was painted many years after his death.

Keywords Physical anthropology, Cranio-facial identification, Facial reconstruction method

It's elementary my dear Watson! A more effective way to construct the face of a criminal

Charlie Frowd

University of Central Lancashire

Constructing a two-dimensional representation of a criminal's face from memory is a challenging task for an eye witness. If the resulting likeness is identifiable, or could be improved, this would be very valuable for the detection of criminal suspects.

In the current paper, a traditional feature-by-feature method of face construction (PRO-fit) is compared with a new system (EvoFIT) whereby a composite is evolved by the repeated selection and breeding of whole faces. Laboratory-witnesses constructed a pair of composites, first with one system and then the other, and after 3 or 24 hours from seeing a target face.

It was found that EvoFIT produced the most identifiable face when used first, and PRO-fit when used second. The data indicate a general advantage for the evolving approach as a human interface for accessing stored facial memories.

Facial reconstruction of a pathological case

J. Mansilla-Lory, E. Gaytan, L. M. Amezcua-Guerra, A. Vargas-Rodríguez, S. Fernández-Tapia, I. Leboreiro, D. Resnick, M. Martínez-Lavín, M. Villanueva, Carlos Pineda

We describe the archeological and imaging results of a unique specimen (skull and mandible) with leontiasis ossea (LO) that is on display in the National Museum of Anthropology and History in Mexico City. The specimen shows diffuse and irregular periosteal bone proliferation, which produces a grossly nodular appearance involving the neurocranium and the facial skeleton. Plain radiography and helical computed tomography revealed generalized hyperostosis obliterating the maxillary and sphenoidal sinuses and two exuberant bony masses arising from the maxilla with encroachment of the anterior nasal aperture. Currently, LO is a purely descriptive term applied to a variety of osseous conditions that have in common hyperostosis of craniofacial bones leading to a leonine appearance. Clinicians who see such lion-like facies should consider the main causes of LO, which include renal osteodystrophy, Paget disease and, as most likely in this specimen, fibrous dysplasia. By means of the application of the three-dimensional facial reconstruction technique, an approximation of the external visual aspect of this specimen was obtained. The Manchester method was used for reconstruction. Briefly, a cast is taken of the skull and the face is then built up by the addition of facial muscles followed by tissue, fatty deposits, and skin. Data specific to the ethnic origin and body type of the subject determine the depth of the tissues assigned to specific points on the skull. Measurements taken from the skull are used to ascertain the size and shape of the nose, ears, and eyes. Because of the lack of information about soft tissue involvement in LO, standardized measurements were applied for reconstruction.

Keywords Leontiasis ossea, Fibrous dysplasia, Paget disease, Facial reconstruction

Application of the 3D craniofacial identification's technology in the homicide case detection

Yuwen Lan, Ye Ning

Tieling 213 Research Institute, Tieling City, People's Republic of China

There is a vast territory and large population in China. Along with the high-speed development of the economic society, the floating population has increased quickly, and criminal cases have also increased year by year. According to incomplete statistics, there are more than 10,000 cases every year in China of murder and decomposed nameless bodies. Of these, only about 20% include clues or missing persons photographs and DNA samples. The remaining 70% of the cases do not allow investigation and the outstanding cases become permanent.

This paper addresses the problem of the identification of nameless body cases, by utilizing Chinese 3D craniofacial identification technology to process 3D facial reversion to produce a digital image that is similar in appearance to the victims. If the digital image is recognized by relatives and friends of the missing person following media attention, a photograph of the individual may be available for

3D craniofacial identification or DNA analysis to confirm the identity of the deceased.

Since 2001, we have used this technology to produce more than 500 accurate identifications of unknown bodies in China, and it plays an important role in the fight against criminals, the safeguard of social order, and the detection of homicide investigations.

Keywords Technology of 3D craniofacial identification, 3D craniofacial reversion, 3D reconstruction identification

The facial reconstruction of Tut-Ankh-Amum

Gregory Mahoney

University of Dundee

In 2005, National Geographic sponsored a new facial reconstruction of Tut-Ankh-Amun. While the sponsored facial reconstruction was undertaken by Elisabeth Atelier under the direction of the forensic anthropologist Jean-Noel Viglan, there were two other facial reconstructions requested. One was by a team from Yale's Peabody museum and another team was organized by Dr. Zahi Hawass, President of Egyptian Antiquities.

The author was invited to join the Egyptian team organized by Dr. Hawass based upon his work using a virtual facial reconstruction system. With the input of the State of Massachusetts Medical Examiner's Office Forensic Anthropologist Dr. Ann Marie Mires, a reconstruction was completed in a relatively short period of time.

As it is not often that three facial reconstructions are undertaken simultaneously, and this paper will discuss the three reconstructions, their similarities, and differences.

This paper will also discuss some of the technical difficulties and future possibilities realized during the virtual facial reconstruction process. Issues discussed will revolve around problems encountered adapting old techniques to new technologies. The author will also discuss issues encountered while exploring the possibilities of texturing the created model. Models created within 3D modeling softwares can consist of millions of triangles, which can tax the computing power of most computers. A method for lightening the model be discussed that decreases the structure of the model, while retaining the accuracy of the reconstruction. This allows for many possibilities were the model to be textured and animated.

Obtaining evidence from child witnesses using video parades

Amina Memon[1], Catriona Havard[1], Brian Clifford[1], Fiona Gabbert[2]

[1]University of Aberdeen; [2]University of Abertay, Dundee

In the UK, there have been an increasing number of children being asked to give evidence as witnesses in criminal cases and view video line-ups to identify perpetrators. However, little research has investigated how well children perform using this type of identification procedure. In this study, 68 children aged 13–14 years witnessed a staged event, where an unfamiliar man (target) interrupted a class. Following a delay of several days, the children were presented with a video parade or photographic lineup. In a second study, we examined the effects of a change in the target's appearance (hairstyle) on identification. The forensic implications of the results are discussed.

A comparative study between 2D manual, 3D manual, and 3D computerized facial reconstruction techniques

Caroline Needham, Caroline Wilkinson, Chris Rynn

University of Dundee

A comparative study of facial reconstructions produced from the skull of an unknown male was initiated by the Second International Conference on Reconstruction of Soft Facial Parts (RFSP 2005, Remagen). Twenty-three individuals took part in the study, producing reconstructions following 2D manual, 3D manual, and 3D computerized methodologies. This study will look at just three of these reconstructions (one following each method), each produced by a trained practitioner and each following anatomical-based methods of reconstruction. The reconstructions will be compared for morphological similarities and differences, and the pros and cons of each method will be discussed.

Odontological contribution to a forensic case work of skeletal remains in Miglionico countryside (South Italy): case report

E. Nuzzolese[1], C. Liuzzi[1], G. Quarta[2], L. Calcagnile[2], G. Di Vella[1]

[1]Sezione di Medicina Legale, DiMIMP-Università di Bari Policlinico, piazza G. Cesare, 70125, Bari, Italy; [2]CEDAD, Dip. Ingegneria della Innovazione, Università del Salento Cittadella della Ricerca (S.S. 7 per Mesagne, Km. 7 +300), 72100 Brindisi

The results of a forensic investigation of human remains recovered from the country surrounding Miglionico (South of Italy) discovered by a forester during a search of the countryside in August 2007 are reported.

A total of 286 bone fragments were excavated from the scene and osteological analysis was carried out by two forensic pathologists and a forensic odontologist to ascertain completeness of the skeletons, an inventory of the skeletal material, a possible identification and cause and period of death. Age and odontological assessment was also provided.

The present report points out the results of odontological and radiological analysis of fragments of maxillary bone with teeth present, 25 teeth lost postmortem and 19 fragments of jaws. Findings from morphological, dental and radiological examination, UV illumination in the compact bones and radioisotope scan (^{14}C) revealed these skeletal remains belonged to at least three separate individuals dating from 600 to 1000 AD, thus having an archeological relevance. This case showed the importance of multidisciplinary involvement in forensics.

Possible facial features of the "Oseberg Queen" and the "Gokstad Chieftain" from the Viking age: a tentative reconstruction

Per Holck

Department of Anatomy, University of Oslo

We all know that reconstruction of faces, historical or modern, based on skeletal remains alone, is difficult and often includes misinterpretations. However, if the presence of pathological traits can be pointed out, these may sometimes indicate special features which can be a useful supplement in the identification work.

In Norway, the skeletal remains from two famous Viking ships, the one from Oseberg and the other from Gokstad, have been

examined anew after the mounds were reopened last year. Even if the bony remains found inside these ships are highly incomplete, they still display some pathological traits which make it possible for us to "reconstruct" some of the features of two high-ranked persons who lived nearly 1200 years ago.

The skull base of the Chieftain from Gokstad displayed a broad and flattened *sella turcica.* He obviously suffered from a pituitary tumor which explains the extreme muscle attachments on his skeleton, and we may think that he had acromegaly, with coarse facial features and big hands and feet.

The female skull from the Oseberg ship displayed an irregular bony thickening of the inner surface of the frontal bone—a so called *hyperostosis frontalis interna*. There is therefore reason to believe that the "Oseberg Queen" suffered from the Morgagni-Stuart-Morel-syndrome, a rare hereditary condition characterized by hirsutism, short neck, virilism, and probably also a reduced mental condition.

Geometric morphometric analysis of sexual dimorphism in South African Blacks

Patrick Randolph-Quinney

University of Dundee

The assessment of sexual dimorphism routinely utilizes discriminant function analyses (DFA) of cranial and postcranial size variables. Some of these utilize univariate discriminant functions to segregate specimens around a predetermined sectioning point, while others employ multivariate discriminant functions including Mahalanobis Distance and Canonical Variates Analysis. However, metrical assessment presents a suite of problems in determining the morphological bases of sex and ancestry, particularly when using software-based multivariate methods such as FORDISC or CRANID. In practice, the strength of association of biological affinity is heavily influenced by the type of statistical contrasts used to discriminate between groups, and tests need to be applied with caution and a clear understanding of the underlying statistical and methodological principals. This paper investigates the dichotomy between morphological and morphometric approaches to the assessment of biological affinity, and presents a statistical comparison of DFA based on the results of linear morphometry versus geometric morphometric analysis of shape. Randomized cross validation is used to explore the partitioning of crania of known sex and ancestry from the Raymond Dart Collection, Johannesburg, South Africa. Results from FORDISC 3.0 will be compared to discriminant functions derived from three-dimensional generalized Procrustes analysis. The implications for the assessment of sexual dimorphism within this sample and forensic human identification will be discussed.

Facial characterization and facial growth

Stephen Richmond

Evaluating dental and facial change as a result of orthodontic treatment in a growing child is difficult. Traditionally, dento-facial growth has been evaluated using model and cephalometric analyses. Surprisingly, less attention has been given to soft tissue evaluations seeing this is the most visible part of the face and shows greater change than the underlying skeletal framework particularly from the age of 11–20 years. Three-dimensional assessment of growth and treatment changes enables quantification in terms of surface topography/area and volume. Growth becomes more complex as facial anatomical landmarks do not exist in the same sense as projected landmarks. The aim of this study is to demonstrate three-dimensional changes/growth of the face in a concurrent sample of 50 children from the age of 11–16 years of age. The growth of the individuals will be presented on a standardized framework with a common origin highlighting different growth patterns. The growth patterns will be discussed in the context of different facial characteristics based on the facial continuum (Faceometer) derived from a large population study. The use of growth prediction based on different facial characteristics at the age of 12 years will be discussed. In addition the influence of medical condition on face shape will be highlighted.

The evolution of forensic dentistry in Istanbul, Turkey: samples of forensic odontology works in a chronological manner

Huseyin Afsin, A. Sadi Cagdir, Yalcin Buyuk

The Ministry of Justice, Council of Forensic Medicine, Third Specialization Board of The Council, Istanbul, Turkey

Forensic odontology has three major areas of utilization: diagnostic and therapeutic examination and evaluation of injuries to jaws, teeth, and oral soft tissues; the identification of individuals particularly in mass disasters and bite mark analysis particularly in assault cases. Although a very important discipline in forensic sciences, the scientific use of forensic odontology in Turkey is relatively new, starting in 1994.

Our first case was a homicide case including a bite mark, which was successfully identified and accepted as evidence in court. After this time, papers on the application of dentistry in forensic cases emerged in Turkish Forensic Journals.

This presentation will attempt to summarize the history of forensic dentistry with sample applications carried out in the Council of Forensic Medicine of Turkey.

Keywords Forensic odontology, Identification, Bite mark, Mass disasters

Helping the police with their enquiries; improving the use of face images in criminal investigations

Vicki Bruce

Newcastle University

In this talk I will describe recent research aimed at improving the quality of composite images, constructed by witnesses to crimes, and the use of CCTV images, which may be captured at crime scenes.

Both types of image create problems if taken into court as evidence, but may be extremely useful if used in the investigation stage. Difficulties with the use of both kinds of image arise because of the ways in which we perceive and remember unfamiliar faces.

Our recent work at the University of Stirling on face composite systems has shown advantages for using multiple composites, where available, in combination, and has also shown a major enhancement in identification rates if composites are shown in varying amounts of caricature.

Prediction of nasal morphology from the skull

Chris Rynn

University of Dundee

The aim of the research outlined in this presentation was to compose a reliable and readily reproducible method of predicting nasal morphology from the nasal aperture and local bone: a method which restricted subjectivity while allowing anatomical nuance to be taken into account. Clinical head CT data from a sample of 79 North American subjects of varied ancestry were analysed for inter-relationships between the bone and soft tissue of the nose in three dimensions, then pooled with 60 lateral cephalograms of subjects of European ancestry from England to augment nasal profile data. A series of simple regression equations was produced using linear distances between pairs of bony landmarks to predict nasal profile dimensions, allowing incorporation of Gerasimov's "Two-tangent" method yet restricting potential subjective error. Maximum nasal width, the position of the alae and nostrils, and prediction of nasal asymmetry were incorporated into the resulting three-dimensional nasal prediction method.

Confidence tricks: uncertainty in measurement and modelling of the human face

Damian Schofield

RMIT University, Australia

Facial identification is increasingly important in many forensic contexts. This is partly due to the ubiquitous use of closed-circuit television (CCTV) as a security device and to provide evidence of criminal activity. However, the CCTV images used in courtrooms are often low resolution and of poor quality.

According to some industry experts, facial identification is also the most controversial of all biometrics. There are many lingering questions regarding the practical usefulness of facial identification technology in courtrooms and the methods employed by current experts. Forensic experts may try to derive facial shape measurements from CCTV footage or stills and say that there is a certain chance of them matching a defendant, but there are concerns that this practice may lead to miscarriages of justice. In March 2003, the UK court of appeal warned that there was at that time little or no scientific basis for these comparisons.

Although facial recognition technology has not, in the past, been proven to be an accurate and effective way of identifying terrorists or suspects in a courtroom, some of the proposed post-September 11 uses of the technology, such as in immigration and airport security, have been generally welcomed by the public.

The computer-assisted facial recognition project described in this paper involved the development of novel methods of evidential facial comparison in a large-scale collaborative research programme that provided a benchmark for the understanding of human facial variation in three dimensions. The project was sponsored by the US government (TSWG—T-216E) and led by the Federal Bureau of Investigation (FBI). A multidisciplinary team including researchers from a number of UK universities, were brought together to tackle this complex problem.

The project was intended to offer various legal jurisdictions high quality statistical forensic evidence as to whether a suspect can be excluded or included as an offender via an associated facial match probability. The work involved statistical analysis of variation in facial measurements in three-dimensional and the development of novel algorithms for making two- and three-dimensional comparisons between faces, facial image capture from video streams and automatic detection of facial landmarks.

This paper specifically focuses on some of the issues, errors and uncertainty encountered both in the measurement of a human face and modelling mechanisms used to subsequently represent the face.

The devil is in the detail

Ronn Taylor, Joe Palamara, Roy Judge

The University of Melbourne

In the case of death a person's remains are returned to the grieving families, long before any legal process of police investigations, coronial inquests or criminal trials are complete.

At criminal trials, the ability of the forensic specialist to demonstrate or accurately describe injury patterns, trauma or specific anatomical features of the deceased are compromised when the original skeletal material is unavailable. Two-dimensional photographs are limited in their capacity to depict the true 3D nature of penetrating wounds and sites of trauma.

Case reports will be presented in which different aspects of forensic disciplines were employed in the identification of human remains and trauma patterns.

- Following incineration and the assessment of bite marks found in a sandwich at the scene.
- Exhumation of human remains after 12 years to re-examination cause of death problems encountered in the investigations will be discussed.

The main concern in duplicated forensic evidence is the dimensional accuracy and surface detail reproducibility. Firstly the impression material's ability to reproduce fine surface detail under dry and moist conditions with the physical properties that exhibit outstanding release properties, high elasticity, flexibility and tear resistances to under cuts with a low linear shrinkage. Secondly when the impression is combined with a hard backing to form the mould it should rigid enough to maintain is overall shape on the removal of the original from within the impression. Thirdly the casting material itself must be able to reproduce the same fine surface detail as the impression and minimal dimensional change.

This allows for the investigations to run concurrently or allows for both the prosecuting and defence authorities simultaneous access to important information.

Comparative study in facial reconstruction: call for participants

Ronn Taylor[1], Caroline Wilkinson[2]

[1]University of Melbourne; [2]University of Dundee

There are currently numerous automated, manual and computerised techniques for facial reconstruction, and many are utilised in forensic investigation without published accuracy or reliability evaluation. With each new scientific development the call for a formal comparative study of facial reconstruction has grown louder.

Previous comparative studies have not assessed practitioner reproducibility with any degree of scientific rigour and have studied students and semi-trained professionals alongside experienced experts. It is not surprising then that the results have demonstrated a low level of reproducibility.

The aim of the researchers is to carry out a comparative study including experienced facial reconstruction practitioners, and evaluate the resulting reconstructions using a standardised and scientifically valid method of assessment. The skull of a known living person will be utilised from CT data and the resulting facial reconstructions will be compared directly with the face of the individual and each other using CT data and anthropometrical software.

Three-dimensional facial reconstructions will be evaluated using CT scanning, so that automated and manual techniques can be compared using the skull as the alignment point, and 2D facial

reconstructions will be compared against each other and the 3D reconstructions using identical skull position for alignment.

The participants will also act as a peer review committee in the form of resemblance rating assessments.

The researchers hope that previous so-called comparative studies have not had a detrimental effect upon such collaborative research and ask for the involvement of experienced practitioners with forensic experience to take part in this study. All participants will be credited for their involvement on any resulting publications and involvement of the participants in the evaluation and scientific method will be encouraged. Practitioners using 2D, 3D, automated or manual methods are all welcomed and CT scans, skull images and/or replicated skulls will be available to all participants on application. Contact Ronn on r.taylor@unimelb.edu.au for further details.

Digital face transformation

Bernard Tiddeman, David Perrett, David Hunter, Yu Meng, Jingying Chen

St Andrews University

The alteration of facial images along perceived attributes such as age, gender or attractiveness has application in psychology research, police investigations, medicine and entertainment. In this talk I will present an overview of our face transforming algorithms, including the basic 2D approach and extensions to improve skin texture and to process 3D and video data. The basic approach is based on prototype (i.e., average) images produced by a process of image warping and blending. This process tends to lose texture information (e.g., wrinkles) and so additional algorithms have been developed to better capture textural details and use them when transforming. These methods have included wavelet and Markov Random Field models. The 2D methods can work well on standardised frontal face images, but less well with unstandardised images. We are currently investigating the use of unstandardised family photos to learn more personalised ageing. Due to the large variability in pose, lighting and expression we are using 3D face models adapted to the 2D images in order to standardise pose and lighting before learning the ageing functions. Finally we are also investigating the use of dynamic models to improve the transformation of faces in video. Our current system uses tensor-face and auto-regression models for the dynamic transformation process.

Facial soft tissue thickness in Japanese children

Hajime Utsuno[1], Toru Kageyama[2], Keiichi Uchida[3], Mineo Yoshino[4], Hiroo Miyazawa[5], Katsuhiro Inoue[1]

[1]Department of Oral Anatomy, [2]Department of Orthodontics, [3]Department of Oral Radiology, Matsumoto Dental University, Nagano; [4]First Medico-Legal Section, National Research Institute of Police Science, Chiba; [5]Department of Pediatric Dentistry, Matsumoto Dental University, Nagano

Facial reconstruction techniques used in forensic anthropology are based on standardized soft tissue thickness measurements. Numerous studies of facial tissue thickness in adults from a range of racial backgrounds have been published. Data on facial thickness in children derive primarily from Caucasian, African-American and Hispanic subjects. There is limited data from the few studies of Japanese children (male: skeletal I type only; female: all skeletal types). The author has previously reported facial tissue thickness data for both male and female skeletal I type Japanese children and for all three skeletal types in Japanese female children. The present study reports facial soft tissue thickness data in Japanese children of all skeletal types, and within age subsets.

With parental informed consent, diagnostic lateral cephalometric X-ray images, obtained from 339 Japanese children aged 7–18 years (male: 162; female: 177) who attended the Department of Orthodontics, Matsumoto Dental University to undergo orthodontic treatment, were employed in the study. Soft tissue and skeletal features in the X-ray images were traced onto acetate sheets, and 10 anthropological landmarks on the mid-sagittal line were measured. Means, SDs and range were then calculated. Differences between male and female measurements in six age groups were compared using *t* tests. Significant differences were observed at some landmarks in each age group. The findings were compared with data from other child populations.

Soft tissue thickness in children

	Male ($n = 17$)			p	Female ($n = 30$)		
	Mean	SD	Range		Mean	SD	Range (mm)
7 and 8 years old							
g	4.90	0.56	1.91	ns	4.75	0.95	5.00
n	5.86	0.97	3.18	ns	5.75	1.13	4.45
rhi	2.78	0.57	2.09	ns	2.50	0.60	2.18
sn	11.11	0.85	2.82	ns	10.85	1.55	6.09
ls	14.60	1.62	5.55	ns	13.74	1.67	7.09
sto	4.85	1.80	7.36	ns	4.51	1.79	6.91
li	14.83	1.49	5.64	ns	15.25	1.60	7.82
lbm	12.29	2.63	10.18	*	13.88	2.39	10.45
pog	13.29	3.28	9.27	ns	13.43	3.09	11.54
gn	6.25	1.58	4.73	ns	6.33	1.60	7.45
	Male ($n = 35$)			p	Female ($n = 53$)		
	Mean	SD	Range		Mean	SD	Range (mm)
9 and 10 years old							
g	5.24	0.83	3.09	ns	5.10	0.85	3.36
n	6.05	0.91	3.91	ns	5.92	0.98	4.82
rhi	2.94	0.69	2.91	ns	2.76	0.73	3.46
sn	11.99	1.57	5.73	ns	11.45	1.34	6.18
ls	15.22	1.84	7.55	*	14.17	1.98	9.00
sto	4.34	2.03	9.09	ns	4.47	1.72	7.27
li	14.69	1.73	8.36	ns	15.09	1.70	7.27
lbm	13.62	3.27	13.09	ns	13.55	2.81	12.18
pog	13.35	3.72	14.27	**	11.31	2.28	13.37
gn	6.48	1.58	5.91	ns	6.52	1.64	7.46
	Male ($n = 40$)			p	Female ($n = 44$)		
	Mean	SD	Range		Mean	SD	Range (mm)
11 and 12 years old							
g	5.39	0.78	2.82	ns	5.49	0.74	2.73
n	6.06	0.93	4.45	ns	5.99	1.08	4.82
rhi	3.09	0.62	3.00	*	2.69	0.72	3.27
sn	13.39	1.60	6.09	**	12.31	1.74	6.73

	Male ($n = 40$)			p	Female ($n = 44$)		
	Mean	SD	Range		Mean	SD	Range (mm)
ls	15.61	2.21	8.73	*	14.73	1.59	7.82
sto	4.16	1.07	5.09	ns	4.49	1.53	6.00
li	15.15	1.25	5.09	ns	14.93	1.71	9.18
lbm	13.63	2.61	12.82	ns	13.04	2.16	9.91
pog	13.16	2.87	13.82	*	11.92	2.33	13.27
gn	6.82	2.12	11.36	ns	6.35	1.57	6.64
	Male ($n = 31$)			p	Female ($n = 15$)		
	Mean	SD	Range		Mean	SD	Range (mm)
13 and 14 years old							
g	5.46	0.90	3.64	ns	5.35	0.69	2.45
n	6.52	0.94	3.82	ns	6.16	0.46	1.45
rhi	2.94	0.75	3.45	ns	2.67	0.52	1.82
sn	15.41	1.91	7.18	**	13.09	2.13	8.36
ls	16.50	1.98	7.64	**	14.48	2.04	6.82
sto	4.31	1.03	5.45	ns	4.35	1.62	7.00
li	16.09	1.22	5.36	ns	15.74	1.64	6.36
lbm	13.90	2.30	11.18	ns	13.43	3.07	11.72
pog	13.99	3.07	10.64	ns	12.98	1.58	5.82
gn	6.77	1.59	5.91	ns	7.04	1.56	5.36
	Male ($n = 25$)			p	Female ($n = 16$)		
	Mean	SD	Range		Mean	SD	Range (mm)
15 and 16 years old							
g	5.79	0.92	4.00	ns	5.74	0.87	2.64
n	6.72	1.28	5.18	ns	6.09	1.25	4.55
rhi	3.04	0.80	3.73	ns	2.72	0.74	2.91
sn	16.18	1.67	7.45	**	13.81	1.69	6.18
ls	17.20	1.75	6.36	**	14.26	1.38	4.91
sto	4.60	1.62	6.18	ns	3.84	1.30	4.55
li	16.88	1.20	4.27	**	15.65	1.52	5.27
lbm	14.55	2.38	11.64	ns	14.82	2.68	10.18
pog	15.27	2.47	9.55	**	12.14	2.00	7.00
gn	7.81	2.13	8.55	*	6.26	1.46	4.55
	Male ($n = 14$)			p	Female ($n = 19$)		
	Mean	SD	Range		Mean	SD	Range (mm)
17 and 18 years old							
g	5.58	0.57	0.57	ns	5.63	0.50	4.55
n	7.05	1.14	1.14	ns	6.37	0.92	4.55
rhi	3.05	0.47	0.47	*	2.67	0.41	2.09
sn	16.23	1.34	1.34	**	13.81	1.93	10.45
ls	16.40	1.58	1.58	*	14.64	2.12	10.45
sto	4.32	1.09	1.09	ns	3.71	1.36	1.18
li	16.10	1.55	1.55	ns	15.28	1.40	13.27
lbm	14.06	2.87	2.87	ns	14.62	2.73	10.55
pog	14.73	3.28	3.28	ns	15.76	3.61	10.18
gn	7.62	1.74	1.74	ns	7.03	1.48	4.45

* $P < 0.05$; ** $P < 0.01$

Sex difference in facial soft tissue thickness at various points of measurement

Age	Measurement points									
	g	n	rhi	sn	ls	sto	li	lm	pog	gn
7 and 8	–	–	–	–	–	–	–	*	–	–
9 and 10	–	–	–	–	*	–	–	–	**	–
11 and 12	–	–	*	**	*	–	–	–	*	–
13 and 14	–	–	–	**	**	–	–	–	–	–
15 and 16	–	–	–	**	**	–	**	–	**	*
17 and 18	–	–	*	**	–	–	–	–	–	–

Sex difference. * $P < 0.05$; **$P < 0.01$

Technological advances in computer-based craniofacial reconstruction

Dirk Vandermeulen

Medical Image Computing Centre, Leuven, Belgium

Recent computer-based approaches for craniofacial reconstruction will be presented. More in particular the "Leuven" approach, which uses a (semi)-automated method based on a statistical model of the inter-relationship between skull and skin surface. Other methods will be compared with it and a number of ways to validate these procedures will be discussed.

Facial reconstruction: an art or science?

Ludo Vermeulen

Facial reconstruction is often considered as the most subjective—as well as one of the most controversial—technique in the field of forensic anthropology. Despite this controversy, facial reconstruction has frequently proved successful results. In the early days of facial reconstruction, scientists worked together with artists to realise the reconstruction. Research and methodological developments continue to eliminate the subjective input and to achieve a reproducible reconstruction. On the other hand, we see that facial reconstructions for historical purposes and the entertainment industry are realised by artists to humanise the result. Is an artistic input necessary, or is the facial reconstruction an art based on scientific research?

The face of Bach

Caroline Wilkinson and Janice Aitken

University of Dundee

It is 250 years since the death of Johann Sebastian Bach, the famous German composer. There is only one portrait of Bach, where it is known that the great musician sat for the painter, Haussmann, and although historians can build a picture of many details from the life of Bach, his facial appearance is still uncertain.

Recently the University of Dundee carried out research into the facial appearance of Bach in collaboration with the Bachhaus museum, in Bach's hometown of Eisenach.

A bronze copy of the skull of Bach was produced by the anatomist Wilhelm His in the late nineteenth century, and using a laser scan of this cast and a computer-based facial reconstruction system, a three-dimensional model of the head of the composer was recreated.

The existing portrait of Bach and documents, which described his eye problems, were then utilised to provide texture and colour to the head, and a short hair style was estimated.

This paper will describe the techniques used for this reconstruction and discuss the accuracy and reliability of the depiction of such historic figures.

The facial analysis of the Lewis Chessmen

Caroline Wilkinson[1], Mark Hall[2], David Caldwell[3]

[1]University of Dundee; [2]Perth Museum & Art Gallery; [3]National Museum of Scotland

David Caldwell and Mark Hall are currently undertaking a research project re-evaluating the hoard of gaming pieces found on the Isle of Lewis, Scotland in the early nineteenth century, and popularly known as the Lewis chessmen.

In examining the pieces for clues as to how many carvers/craftsmen might have worked upon them they approached Dr. Caroline Wilkinson (University of Dundee), to see if the techniques of forensic anthropology could add any new insights to the study of the carved faces. A facial morphology assessment of the Lewis Chessmen was carried out, following the techniques usually applied to forensic identification.

The difficulty in finding the correct soft tissue thickness for Vietnamese people

Steffi Burrath

State Criminal Investigation Department of Saxony-Anhalt

By chance a 10-year-old case found its way into my office. Two skeletons, which appeared to be Asian, were discovered in a forest in our country in 1996. One of them had a Vietnamese passport in his clothes—but they were still unknown. What was the reason?

The presentation will display, on the basic of an interesting case, the search and development of the right measurement data for these Vietnamese. The data were generated as a mix between European, Korean, Japanese and Chinese databases taking into account databases for special thickness.

The case clarifies some mistakes which were made during the first inquiries and presents at the end the results of the reconstruction—two identified person—and a measurement list which can be used for other reconstructions of Vietnamese people in the future.

Furthermore the author would like to suggest an international database collection for measurement data be initiated.

Facial image analysis as expert evidence in court

Xanth D. G. Mallett-Telling

University of Dundee

The aim of this paper is to present a summary of the most important admissibility criteria affecting forensic facial image analysis, and experts presenting such evidence in judicial proceedings. The context surrounding the development of techniques and the relevance of suitable and reliable statistical interpretation will also be discussed.

A summary of biometric facial identification methods will be given, including details of landmarking procedures for the assessment of facial identification, in the context of the legal requirements surrounding the production, interpretation, and presentation of such evidence in court. Awareness of the current legal criteria will be highlighted as integral for any expert giving evidence in court, as are the concepts of evidential reliability, relevance, probative worth, and absence of prejudice.

The current expert evidence admissibility criteria will be discussed, in terms of their suitability for purpose. In conclusion, suggestions will be made regarding potential ways in which the current system could be more suitable for the assessment of innovative and complex scientific evidence.

A comparative study of ancient and modern Romanian skulls

Carmen Simona Ionescu[1], M. Yaşar İşcan[2], Dan Botezatu [3], Georgeta Miu[3]

[1]Institutul de Medicina Legala, str. Bunavestirii nr. 4, Iasi, Romania; [2]Istanbul University, Institute of Forensic Sciences, Cerrahpasa, Istanbul, Turkey; [3]Anthropological Center of Romanian Academy, Iasi, Romania

From the scientific study of ancient skeletal remains, significant information (e.g., health, diet, genetic, evolution, and demography like age-at-death, sex ratio, body size) about that population can be gained. The purpose of this paper is to investigate metric characteristics of skeletal remains from persons who lived in modern and medieval Romania. The modern sample is composed of 82 male and 86 female skulls belonging to the Francisc Rainer collection (Bucharest), gathered during 1920 to 1943 from autopsy room. A total number of 225 skulls (102 males and 123 females) were selected from the medieval skeletal remains found in a necropolis from Mihalaseni (Botosani county) in the 4th–5th century CE. Twelve cranial and six mandibular dimensions were taken from each individual specimen using a digital sliding and spreading calipers. The data were entered into SPSS for analysis. Independent samples test was performed, showing that cranial length, cranial breadth, bizygomatic breadth, minimum ramus breadth, orbital breadth for males and cranial length, minimum frontal breadth, upper facial height, nasal breadth bicondylar breadth, bigonial breadth, ramus height, and minimum ramus breadth for females are statistically significant ($p < 0.05$). The morphological differencies between the modern and medieval skulls were estimated by reconstructing pictures and three dimensional face. Facial reconstruction was made manually by plasticine. In conclusion, there is a considerable change in the cranial dimensions from about the fifth century (Mihalaseni) to the modern time (Rainer). In males,

the most statistically detectable change seem to occurred by a reduction in cranial length through time. The females follow the similar line of cranial reorganization, but the facial morphology (distances from basion to bregma, to nasion, and to prosthion are also changed through time. It may be assumed that Eastern Europeans may have gone through socioeconomic stress, and differential mortality resulting from changes in the facial skeleton and genetic composition with neighboring populations including ancient Romanians some 1,500 years ago.

Keywords Skull, Osteological collection, Ancient and modern Romanians, Photo comparison, Facial reconstruction